



Mark Scheme (Results)

June 2022

Pearson BTEC Nationals
In Applied Science (31627H)
Unit 5: Principles and Applications of Science II -
Chemistry

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Unit 5: Principles and Applications of Science II

General marking guidance

- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Marking grids should be applied positively. Learners must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should mark according to the marking grid, not according to their perception of where the grade boundaries may lie.
- All marks on the marking grid should be used appropriately.
- All the marks on the marking grid are designed to be awarded. Examiners should always award full marks if deserved. Examiners should also be prepared to award zero marks, if the learner's response is not rewardable according to the marking grid.
- Where judgement is required, a marking grid will provide the principles by which marks will be awarded.
- When examiners are in doubt regarding the application of the marking grid to a learner's response, a senior examiner should be consulted.

Specific marking guidance

The marking grids have been designed to assess learner work holistically. Rows in the grids identify the assessment focus/outcome being targeted. When using a marking grid, the 'best fit' approach should be used.

- Examiners should first make a holistic judgement on which band most closely matches the learner's response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer, in response to the assessment focus/outcome and will be modified according to how securely all bullet points are displayed at that band.
- Marks will be awarded towards the top or bottom of that band, depending on how they have evidenced each of the descriptor bullet points.

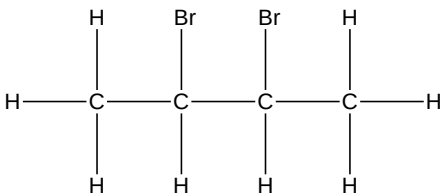
BTEC Next Generation Mark Scheme

Question Number	Answer	Additional Guidance	Mark												
1 (a)	Award one mark for any of the following, up to a maximum of two marks: • malleable • lightweight / low density • non-toxic • non-permeable / waterproof • corrosion resistant / does not corrode Accept any other valid response.	accept ductile accept does not react with contents / surroundings allow strong /durable allow does not dissolve do not accept conducts heat, conducts electricity, high melting point, high boiling point	2												
1 (b)(i)	A bauxite		1												
1 (b)(ii)	$\text{Al}_2\text{O}_3 + 2\text{NaOH} + 3\text{H}_2\text{O} \rightarrow 2\text{NaAl}(\text{OH})_4$	accept multiples if “Al ₂ O ₃ + 2NaOH” is correctly modified	2												
1 (b)(iii)	Award one mark for each row completed correctly <table><tr><th>compound</th><th>acid</th><th>base</th></tr><tr><td>aluminium oxide</td><td>☒</td><td>☒</td></tr><tr><td>calcium oxide</td><td>☐</td><td>☒</td></tr><tr><td>sodium hydroxide</td><td>☐</td><td>☒</td></tr></table>	compound	acid	base	aluminium oxide	☒	☒	calcium oxide	☐	☒	sodium hydroxide	☐	☒	Accept crosses, ticks, circles, etc	3
compound	acid	base													
aluminium oxide	☒	☒													
calcium oxide	☐	☒													
sodium hydroxide	☐	☒													

1 (c)(i)	Award one mark for any of the following up to a maximum of two marks: (aluminium) ions are {positive / positively charged} (1) (ions) {attracted / carry electrical current} to {cathode / negative electrode} (1) (ions) {gain electrons / reduced} (at negative electrode) (1) Accept any other valid response.	accept reference to Al^{3+} if no other mark awarded then allow reference to use of electricity for 1 mark	2
1 (c)(ii)	Award one mark for any of the following: aluminium is more reactive than carbon / ORA (1) aluminium is purer when extracted by electrolysis / ORA (1) Accept any other valid response.	accept better atom economy / less waste allow less energy is required (using electrolysis)	1

1 (c)(iii)	Award one mark for identification and one mark for appropriate expansion. Identification: (membrane is used to keep) {products / electrodes} separate / ORA (1) Award 1 mark for any of the following expansion points: difference in the {density / state of matter} of the products (1) aluminium {sinks / goes to the bottom (of the cell)} (1) oxygen is a gas / oxygen goes to the top (of the cell) (1) Accept any other valid response.	accept stop products from {mixing / reacting} accept only allows specific particles / substances through allow oxygen forms carbon dioxide <u>gas</u>	2
Total			13 marks

Question Number	Answer	Additional Guidance	Mark
2 (a)	surroundings	accept environment	1
2 (b)(i)	Award one mark for any of the following: one mole (of alkane / hydrocarbon) (in/of the equation) <u>complete</u> combustion formation of carbon dioxide and water (only)	accept excess oxygen being used / burnt completely in oxygen	1
2 (b)(ii)	Award one mark for any of the following: exothermic (1) give out heat / energy (1)		1
2 (b)(iii)	{combustion of octane / Equation 3} is <u>more</u> exothermic / gives out <u>more</u> heat energy ORA	ecf from 2(b)(ii)	1
2 (c)	 volume change (ΔV) (1) $6 \times 10^{-4} - 1 \times 10^{-4} (= 5 \times 10^{-4})$ substitution (1) $-4100 = -4300 + (6 \times 10^{-4} - 1 \times 10^{-4})p$ rearrangement (1) $p = \frac{-4100 + 4300}{(6 \times 10^{-4} - 1 \times 10^{-4})}$ evaluation (1) 400 000 or 4×10^5 (Pa)	award all four marks for 400 000 or 4×10^5 (Pa) with or without working rearrangement and substitution can be done in any order accept $p = (\Delta H - \Delta U) \div \Delta V$ maximum of three marks awarded for -400 000 maximum of 3 marks for power of 10 error if no other mark awarded then accept 200 for 1 mark	4
Total			8 marks

Question Number	Answer	Additional Guidance	Mark
3 (a)(i)	B butan-2-ol		1
3 (a)(ii)		accept any orientation of the Br atoms accept shortened structural formula	1
3 (a)(iii)	H ₂ SO ₄ / HOSO ₃ H	accept any formula with correct number and type of atoms	1
3 (b)(i)	(species) attracted to {electron rich area / high electron density / electrons in C=C} (1) accepts a <u>pair</u> of electrons (to form a new covalent bond) (1)	allow species which is positively charged / δ+ / electron deficient if no other mark awarded then allow {attract / accept} electrons for 1 mark	2

3 (b)(ii)	Award one mark for each identification and one additional mark for appropriate expansion for each error identified. error 1 identification: (curly) arrow should not be going from H (to C=C / double bond) (1) expansion: (pair of) electrons come from the double bond (to be shared / form new covalent bond) (1) error 2 identification: - H should be (δ)+ / Br should be (δ)- / dipole in HBr is the wrong way round (1) expansion: - Br is more electronegative than H / ORA (1)	accept (curly) arrow should be going from C=C / double bond to H accept H does not donate electrons / H has no pair of electrons to donate accept bromine attracts electrons more strongly accept clear annotation on diagram or a drawing for identification or expansion marks	4
3 (b)(iii)	c $ \begin{array}{c} \text{CH}_3 \quad \text{H} \\ \quad \\ \text{CH}_3 - \text{C} - \text{C} - \text{H} \\ \quad \\ \oplus \quad \text{H} \end{array} $		1

3 (c)	but-1-ene is asymmetrical / <i>cis</i>-but-2-ene symmetrical / ORA (1) Br can add to 1st or 2nd carbon / either {carbon/side} in the double bond in but-1-ene (to form two products) (1) 2nd and 3rd carbon / carbons in the double bond are the <u>same</u> in <i>cis</i>-but-2-ene (so HBr addition gives only one product) (1)	accept a description of the difference of the position of the double bond accept drawings showing addition or position of bromine on 1st and 2nd carbon atoms accept drawing(s) showing addition or position of bromine on 2nd carbon atom with annotation that it is the same as 3rd carbon atom	3
Total			14 marks

Question number	Indicative content	
4	Iron and its ions as catalysts: • all speed up the reactions • lower the activation energy required for the reaction by providing an alternative reaction pathway / route • not used up in the reaction • variable oxidation state / forms different ions Haber process reaction: • iron is a heterogeneous catalyst (in a different phase / state to the reactants) • provides a surface for the reaction • gas molecules are adsorbed on surface of iron • weakens covalent bonds in the gas molecules • less energy required for the reaction Persulfate and iodide reaction: • Fe^{2+} and Fe^{3+} are homogeneous catalysts (same phase / state as reactants) • negative ions repel, positive ions attract negative ions • redox mechanism / gain and loss of electrons with reactants • Fe^{2+} loses / gives electrons to $\text{S}_2\text{O}_8^{2-}$ and becomes Fe^{3+} • Fe^{3+} gains electrons from I^- and becomes Fe^{2+} • original ion is restored at the end of the reaction Accept any other valid point.	
Mark scheme (award up to 6 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.		
Level	Mark	Descriptor
Level 0	0	No rewardable material.
Level 1	1–2	• Demonstrates adequate knowledge of scientific facts / concepts with generalised comments made. • Generic statements may be presented rather than linkages being made so that lines of reasoning are unsupported or partially supported. • The discussion shows some structure and coherence.
Level 2	3–4	• Demonstrates good knowledge and understanding by selecting and applying some relevant scientific knowledge facts / concepts to provide the discussion being presented. • Lines of argument mostly supported through the application of relevant evidence. • The discussion shows a structure which is mostly clear, coherent and logical.
Level 3	5–6	• Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of scientific facts / concepts to provide the discussion being presented. • Line(s) of argument consistently supported throughout by sustained application of relevant evidence. • The discussion shows a well-developed structure which is clear, coherent and logical.



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